Remarks

I. Rejections under 35 U.S.C. § 112, Second Paragraph

Claims 27-34, 46 and 80 are rejected under 35 U.S.C. § 112, second paragraph, as allegedly being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicants regard as the invention. Applicants traverse this rejection and request that it be withdrawn.

Solely to place the claims in condition for allowance, Applicants have amended independent claim 27, from which the remaining rejected claims depend, to state that the oxidant gas delivery system "receives a feed gas comprising an oxidant at a first concentration and produces an oxidant-enriched gas comprising the oxidant at a second concentration greater than the first concentration." The standard, as seemingly required by the Examiner, is the concentration of the oxidant in the initial stream, i.e., the first concentration expressly recited in the claim. A person of ordinary skill in the art will understand that this initial concentration can vary.

Applicants' amendment addresses the 112 rejection, and Applicants request that such rejection be withdrawn.

II. Rejections under 35 U.S.C. § 102

Claims 1, 2, 4-9, 70, 72, 78 and 81-86 are rejected under 35 U.S.C. § 102(b) as allegedly being anticipated by Singh *et al.*, U.S. Patent No. 5,686,196 (Singh). Applicants traverse this rejection, and request that it be withdrawn.

The Examiner states that the "can receive" feature of independent claim 1 is a statement of intended use that does not distinguish Singh. Applicants disagree. Nevertheless, Applicants have deleted the alleged statement of intended result, i.e., "can receive," and have further amended independent claim 1, from which the remaining rejected dependent claims depend, to state that the expander is fluidly coupled to the fuel storage container. This amendment is fully supported by the application as filed. Various embodiments of Applicants' energy recovery technology are described in the text and are illustrated in the figures filed with the application. FIGs. 6A and 6B, for example, illustrate hydrogen storage vessel 250 fluidly coupled to expander 260 by fluid conduit 256.

Applicants also have amended claim 1 to state (a) that fuel in the fuel storage container is at a first pressure, and (b) that energy is recovered from fuel in the fuel storage container as the fuel

expands by pressure change from the first higher pressure to the second lower pressure. This amendment further clarifies distinctions between Singh and the embodiment of Applicants' invention recited in independent claim 1.

Applicants' system has hydrogen stored at a first pressure. Singh also teaches storing fuel, and it inherently must be at a first pressure. But, Singh does not contemplate this fuel, which is at a relatively high pressure, as storing recoverable energy solely by reducing the pressure of the stored fuel. Singh provides no means for recovering such energy, and instead simply does not utilize this stored energy.

This conclusion is cleared supported by Singh's FIG. 1 and the text describing FIG. 1. Singh does teach a hydrogen storage tank, and the illustrated system does include an expander. But in Singh's system, fuel at a first pressure first flows from hydrogen storage to an evaporator and high pressure pump. As a result, any fuel provided from the hydrogen storage is now at a second pressure that is greater than the first pressure. This provides a first distinction between Singh and the embodiment of Applicants' invention recited in claim 1.

Second, Singh must increase the pressure of the hydrogen fuel fed from the hydrogen storage to a second, greater pressure up "to about 10 to 20 atmospheres, and more preferably at least about 15 atmospheres." See, Singh, column 3, lines 1-2. This is required for Singh's system to function properly, as either or all of the hydrodesulfurizer, the reformer, and subsequently the membrane-based hydrogen separator must operate at this second, higher pressure. Singh, column 3, beginning at line 44.

Finally, Singh feeds the high pressure reformed fuel to an expander. Again, the fuel is not at the pressure at which it is stored in the hydrogen storage. And, the sole purpose of the expander is to reduce the pressure of the feed fuel for supply to the fuel cell, which operates at a substantially lower pressure than the membrane-based hydrogen separator. No provision is provided by Singh for recovering energy as a result of the expansion/pressure reduction.

Conversely, Applicants' invention (1) avoids pressurizing the fuel feed to a higher pressure before it reaches the expander, and (2) recovers energy as a result of expansion of fuel as the fuel pressure changes from the first higher pressure to the second lower pressure. For example, with reference to the embodiment illustrated in FIG. 6A, the present application states:

Hydrogen expander 260 is mechanically coupled to compressor 101 in FIG. 6A or to

> vacuum pump 103 in FIG. 6B via schematically depicted shaft 261. Thus, hydrogen expander 260 assists in powering compressor 101. If the compressor 101 is a two-stage compressor, one stage might be powered by shaft 261 and the other stage by motor 105. Although not shown in FIG. 6, hydrogen expander 260 could be coupled to other devices requiring mechanical power such as, for example, a vacuum pump, rotary bed or rotary valve for the PSA module 1 or to external power loads such as vehicle propulsion or air conditioning."

Page 21 of the present application, lines 1-8 (emphasis added). Applicants therefore request that the rejection under § 102 of claim 1, and the claims that depend therefrom, be withdrawn in view of Applicants' requested amendments to independent claim 1 and the distinctions discussed above with respect to Singh's technology.

Claim 7 requires that the system include "at least one heat exchanger containing a working fluid." This phrase clearly connotes structure, i.e., a device, that contains a working fluid. The Office Action contends that the atmosphere is a heat exchanger as claimed by Applicants in claim 7. Applicants disagree with this characterization.

However, solely to place the application in condition for allowance, Applicants have amended claim 7 to state that at least one heat exchanger houses a working fluid. This amendment further establishes that a device, not the surrounding atmosphere, holds the working fluid. For this additional reason, Applicants request that the rejection of claims 1, 2, 4-9, 70, 72, 78 and 81-86 as allegedly being anticipated by Singh be withdrawn.

III. Rejections Under 35 U.S.C. § 103

A. Singh and Ippommatsu

Claims 27-34, 71 and 91-93 are rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Singh further in view of Ippommatsu *et al.* U.S. Patent No. 5,147,735 (Ippommatsu). Applicants traverse this rejection and request that it be withdrawn.

The Office Action contends that Singh discloses Applicants' invention essentially as claimed. As indicated above, Applicants disagree. Independent claim 27, similar to independent claim 1, recites that the system includes at least one expander. The expander is fluidly coupled to the hydrogen storage system to receive hydrogen from the hydrogen storage system at a first pressure and to provide the hydrogen at a second pressure that is lower than the first pressure. The system also includes at least

one oxidant gas delivery system that receives a feed gas comprising an oxidant at a first concentration and produces an oxidant-enriched gas comprising the oxidant at a second concentration greater than the first concentration for delivery to the fuel cell. And, the oxidant gas delivery system includes at least one device that is coupled to the expander. Thus, by recovering energy from expansion of the fuel as the pressure decreases from the first pressure to the second pressure, energy can be recovered for assisting operation of the at least one device coupled to the expander.

Ippommatsu does not cure the deficiencies of Singh with respect to teaching the feature(s), and combinations of such features, of the rejected claims. While Singh may disclose an expander and Ippommatsu may disclose a pressure swing adsorber, these references, alone or in combination, fail to disclose or suggest any relationship between fuel storage and an expander that allows energy recovery by expansion of the fuel fed from the fuel storage container. In fact, as currently understood, Ippommatsu does not disclose an expander of any sort, and hence Singh and Ippommatsu, both alone and in combination, fail to disclose or suggest recovering energy from fuel stored at a first pressure using an expander. For these reasons, Applicants request that the rejection of the claims under § 103 be withdrawn.

Claims 28-34, and 91-93 depend from independent claim 27. Claim 71 depends from independent claim 1. Hence, these dependent claims are allowable for the reasons stated above concerning independent claims 1 and 27, and further in view of the patentable combinations of features recited in such claims.

B. Singh

Claims 87-89 are rejected under 35 U.S.C. § 103 as allegedly being obvious over Singh. Applicants traverse this rejection and request that it be withdrawn.

Claims 87-89 depend from independent claim 1, and are allowable for the reasons stated above with respect to claim 1, and further in view of the patentable combinations of features recited in such claims.

C. Singh and Hornburg

Claim 90 is rejected under 35 U.S.C. § 103 as allegedly being obvious over Singh in view of Hornburg *et al.*, U.S. Patent No. 5,981,096. Applicants traverse this rejection and request that it be

withdrawn.

Hornburg does not teach the features of Applicants' claims 1 that are not taught by Singh. Hornburg teaches using a methanol fuel. Methanol "is fed from a methanol tank 15 by way of a methanol feed pipe 16, and is injected by means of an injection nozzle (not shown in detail) into the anode feed pod 5. The injection pressure is generated by an injection pump 17 arranged in the methanol feed pipe 16." Hornburg, column 3, lines 16-20. Methanol fuel is then "circulated by means of a pump 13 at a defined pressure in order to constantly insure an excess supply of fuel at the anode" as illustrated in the drawing sheet provided by Hornburg. Hornburg, column 3, lines 8-10. Hornburg does teach using an expander, indicated as 12 in the drawing. But, there is no expander in line between the fuel tank and the anode space. It is important to note that the feed into expander 12 is from the fuel cell and not to the fuel cell. Thus, Hornburg does not cure the deficiencies of Singh with respect to teaching or suggesting the features of independent claim 1. As a result, the combination of the two patents cannot teach the combination of features in claim 1 from which claim 90 depends. Claim 90 therefore is nonobvious in view of the combination of Hornburg and Singh.

Claim 90 depends from independent claim 1, and is allowable for the reasons stated above with respect to claim 1, and further in view of the patentable combination of features recited in this claim.

The present application is in condition for allowance, and such action is respectfully requested.

Respectfully submitted,

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